DOE F 5822.1
(5-85)
Formerly EV-618)

U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

OMB Approval
No. 1910-2000

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages.
9904	2	USA/9904/B(U)F-85 (DOE)	1	7

2. PREAMBLE

2a. This certificate is issued under the authority of 49CFR Part 173.7(d).

2b. The packaging and contents described in item 5 below meet the safety standards set forth in subpart E, "Package Approval Standards" and subpart F, "Package and Special Form Tests" Title 10, Code of Federal Regulations, Part 71.

2c. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. This certificate is used on the basis of a safety analysis report of the package design or application --

(1) Prepared by *(Name and address)*:

U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, WA 99352

(2) Title and Identification of report or application:

Radioisotope Thermoelectric Generator Transportation System, Safety Analysis Report for Packaging, WHC-SD-RTG-SARP-001, Revision 0-B and Addendum HNF-SD-RTG-SARP-002, Revision 0, May 1999

(3) Date: 3/6/1998

4. CONDITIONS

This certificate is conditional upon the fulfilling of the applicable Operational and Quality Assurance requirements of 49CFR parts 100-199 and 10CFR Part 71, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Transport Index, Other Conditions, and References:

(a) Packaging

(1) Model No.: RTG Package

(2) Description

The RTG Package is approved for shipping the General Purpose Heat Source (GPHS) Radioisotope Thermoelectric Generator (RTG) and the HPG (High Performance Generator) MOD-3 RTG. The GPHS and the HPG MOD-3 RTGs contain up to 4,500 watts and up to 2,500 watts (thermal) power, respectively, generated from all sources (primarily from the ^{238}Pu isotope). The ^{238}Pu in both RTGs is in the chemical form of PuO_2 and in the physical form of pressed, sintered pellets (cylindrical and spherical, respectively) sheathed in iridium with a filtered vent to release the helium generated by radioactive decay.

6a. Date of Issuance: MAY 27 1999	6b. Expiration Date: May 31, 2001

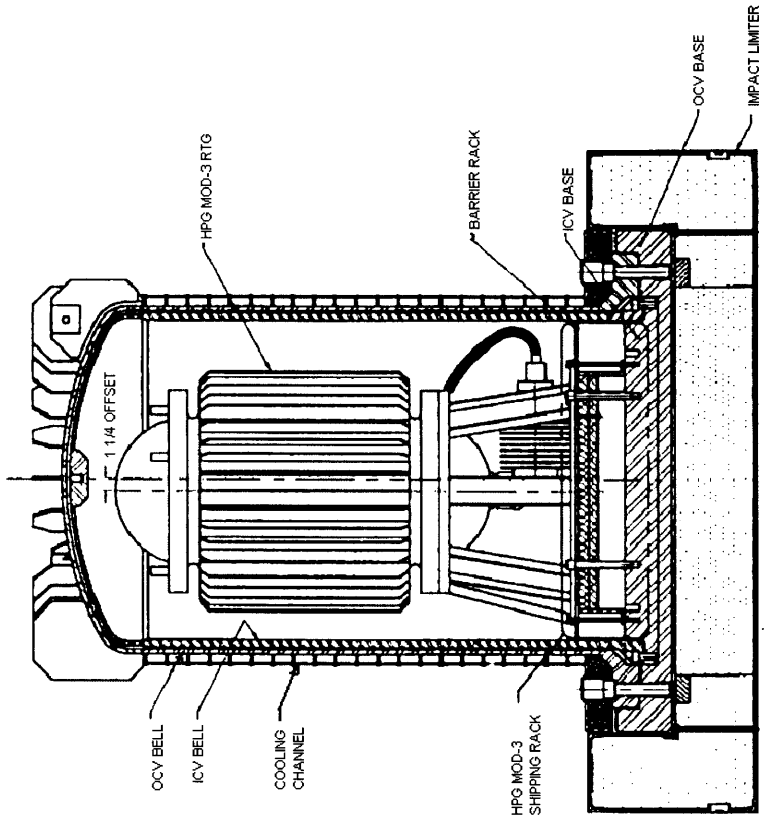
FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address *(of DOE Issuing Office)*	7b. Signature, Name, and Title *(of DOE Approving Official)*
U.S. Department of Energy Office of Site Operations, EM-70 19901 Germantown Road Germantown, MD 20874	Michael E. Wangler Michael E. Wangler, Director Package Approval and Safety Program, EM-70

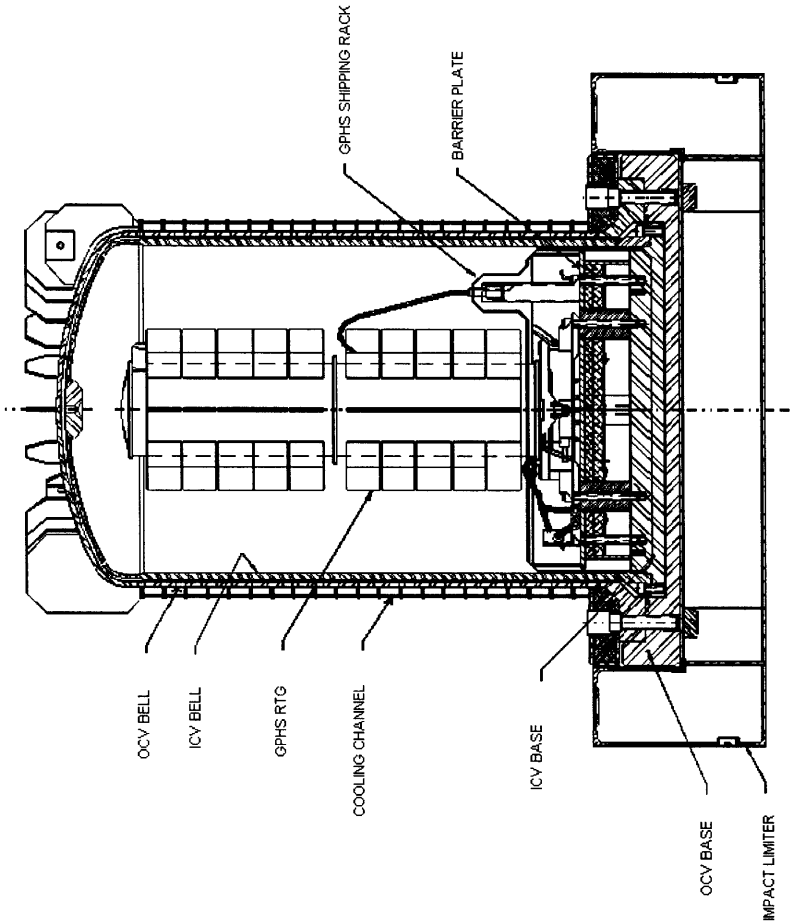
The RTG Package provides double containment as required by 10 CFR 71.63 without taking credit for iridium sheaths or the structural components of the RTG.

The RTG Package containment system (illustrated in Figures 1 and 2) consists of two independent stainless steel containment vessels: an inner containment vessel (ICV) and an outer containment vessel (OCV). The inner and outer containment vessels consist of a bell and a base as shown in Figures 1 and 2. The design of the containment vessels complies with Section III, Subsection NB of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. The containment vessels are designed to withstand all pressure buildups that may occur during the Normal Conditions of Transport (NCT) and Hypothetical Accident Conditions (HAC). No pressure relief systems for the containment boundaries are provided.

Different shipping rack designs (also illustrated in Figures 1 and 2) are used in attaching the GPHS RTG payload and the HPG MOD-3 RTG payload to the ICV base for restraint during normal shipping and handling operations. Both kinds of shipping racks are fastened to the ICV base and are designed to remain in place during an HAC drop to prevent heat-generating payload debris from reaching the proximity of the ICV O-ring seal area. The payload attachment bolts and payload itself are conservatively assumed not to survive the HAC.



RTG Package with HPG MOD-3 RTG
Figure 2



RTG Package with GPHS RTG
Figure 1

Each containment vessel is closed via a bolted flange sealed with an elastomeric O-ring. A second O-ring, outboard of the seal O-ring, facilitates leak testing of the seal O-ring. The containment vessels each have a helium fill (primary vent) port; the ICV also has a secondary vent port. These ports are used to establish a pressurized helium atmosphere inside each containment boundary at the time of loading. In addition, each containment vessel is equipped with a leakage rate test port which accesses the region between the containment O-ring and the leak testing O-ring.

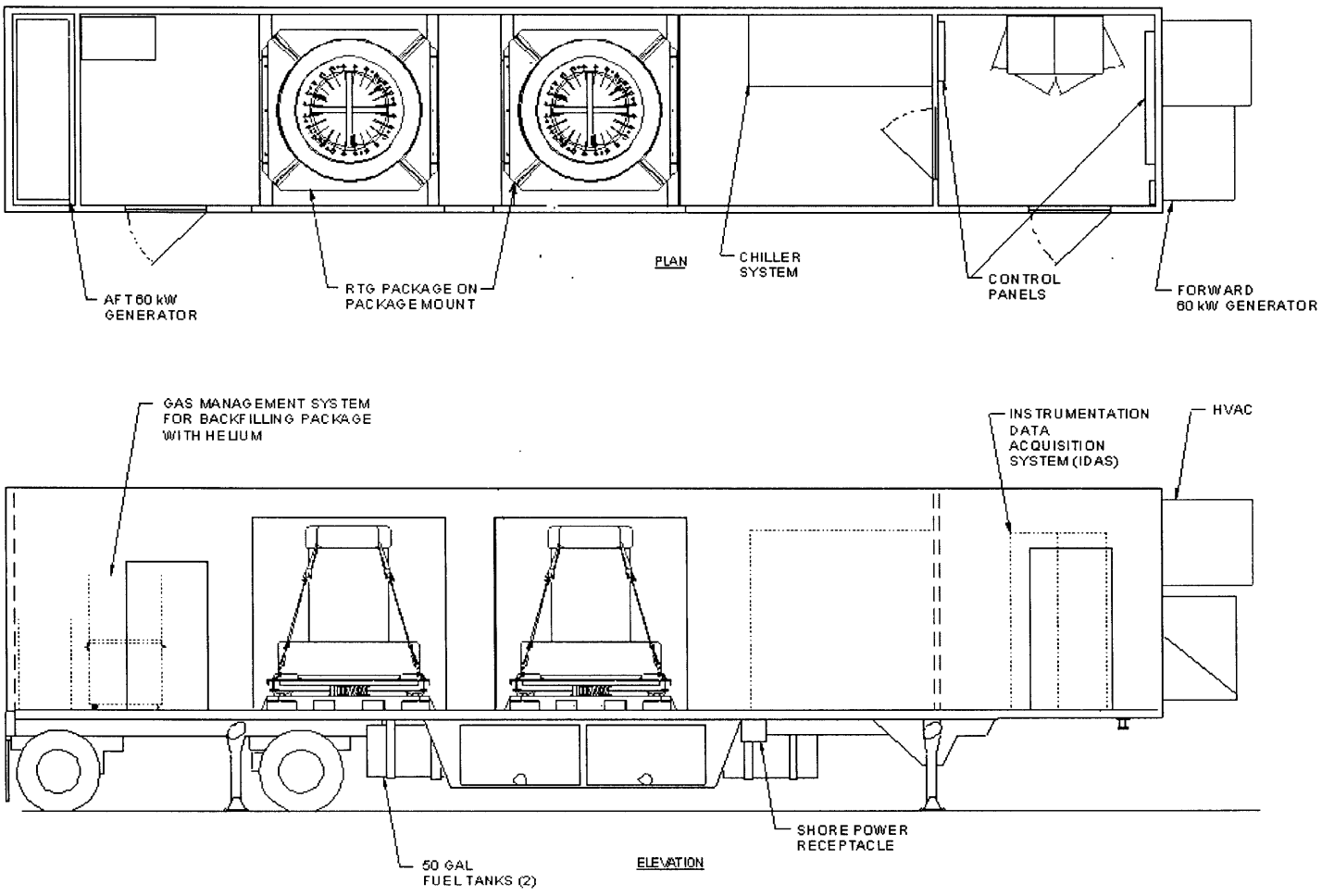
Electrical feed-through assemblies are located within recessed holes in each of the OCV and ICV bases. These assemblies provide a means to continuously monitor the RTG payload during transport. The monitoring of the RTG payload has nothing to do with the regulatory safety compliance of the RTG Package, but is a means of measuring operational parameters affecting the lifetime and performance of the RTG payload. Once installed, the electrical feed-through portion of the containment boundary is never broken; therefore, leakage rate testing at the time of shipment is not required. The electrical feed-through assemblies are leak tested with the entire containment boundary during the acceptance testing. The seals and the electrical feed-through assemblies are tested separately during periodic testing.

The RTG Package is about 196 cm (77 in) high and has a maximum outer diameter (of the impact limiter) of 178 cm (70 in). The cavity dimensions are approximately 145 cm (57 in) high by 86 cm (34 in) in diameter. The maximum gross weight of each package, including payload and limiter, is approximately 4,355 kg (9,600 lb); the empty weight of the packaging is 4,014 kg (8,850 lb).

Lifting the package is accomplished via three of the twenty-four OCV cooling fins, which double as lifting lugs. The ICV is lifted with a single lift point in the ICV head. Because the package is secured to its transport skid with a pair of tie-down straps that pass over the top of the locally-reinforced OCV at right angles to one another, there are no tie-down devices that are an integral part of the package.

The package, with its impact limiter in place, is mounted on its own transport skid (for shock and vibration protection of the RTG payload and denoted "package mount" in Figure 3) and is provided with an active cooling system and passive heat transfer enhancement for thermal protection of the payload. Neither the transport skid nor the active cooling system are claimed toward satisfying the requirements of 10 CFR 71, but the inactive, empty of coolant, cooling channels located on the outer surface of the OCV are considered to be present. The impact limiter is required for thermal protection during the HAC fire.

The package shall be transported within an exclusive use trailer (shown in Figure 3), designed specifically for transport of the RTG Package. The specific dimensions of this trailer were incorporated into the SARP to demonstrate compliance with dose rate limits of 10 CFR 71.47(b).



RTG Transportation System Custom Trailer
(Shown with two RTG packages)
Figure 3

(3) Drawings

Drawing Number	Title	Sheet Number	Revision Level
H-9-5000	General Notes, RTG Transportation Package	1/1	0
H-9-5001	General Assembly and Details, RTG Transportation Package	1/2	0
"	"	2/2	0
H-9-5002	Assembly and Details, Outer Containment Vessel (OCV), RTG Transportation Package	1/5	0
"	"	2/5	0
"	"	3/5	0
"	"	4/5	0
"	"	5/5	0
H-9-5003	Assembly and Details, Inner Containment Vessel (ICV), RTG Transportation Package	1/4	0
"	"	2/4	0
"	"	3/4	0
"	"	4/4	0
H-9-5004	Assembly and Details, Impact Limiter, RTG Transportation Package	1/1	0
H-9-5005	GPHS RTG Shipping Configuration, RTG Transportation Package	1/2	1
"	"	2/2	1
H-9-5006	HPG MOD-3 RTG Shipping Configuration RTG Transportation Package	1/2	0
"	"	2/2	0
H-9-5007	RTG OCV Head Personnel Barrier, RTG Transportation Package	1/1	0
H-9-120	HPG MOD-3 Interface Control Drawing	1/1	0

(b) Contents

The RTG Package contents are limited to one GPHS RTG or one HPG MOD-3 RTG per package. The exclusive use trailer used to transport the package may contain one package containing a GPHS RTG or two packages each containing an HPG MOD-3 RTG. The weight of the RTG and its shipping rack shall not exceed 340.2 kgs (750 lbs). The RTG Package shall contain no more than 11.3 kg of PuO_2 with a total activity of 5.3×10^{15} Bq (1.42×10^5 Curies) if a GPHS RTG is being transported or 6.22 kg of PuO_2 with a total activity of 2.9×10^{15} Bq (7.84×10^4 Ci) if the HPG MOD-3 RTG is being transported. The isotopic composition of the plutonium at the time of precipitation shall be as follows:

Isotope	Weight % of Total Pu
^{236}Pu	≤0.0001
^{238}Pu	80 to 86
^{239}Pu	≤20

The total fissile material (^{238}Pu, ^{239}Pu, and ^{241}Pu) is limited to 9.96 kg per RTG Package. The maximum thermal power of the RTG Package shall not exceed 4,500 watts if a GPHS RTG is being transported or 2,500 watts if an HPG MOD-3 RTG is being transported. The maximum neutron emission rate of the GPHS RTG shall not exceed 5.14×10^7 n/s. The maximum neutron emission rate of the HPG MOD-3 RTG shall not exceed 2.83×10^7 n/s.

(c) Transport Index: 1. RTG Package containing one GPHS RTG: 100
2. RTG Package containing one HPG Mod-3 RTG: 50

(d) Conditions

(1) The RTG Package may be transported only by exclusive use in the vehicle shown in Figure 3.

(2) The RTG Package may not be used to transport RTGs by air.

(3) The RTG Package is subject to and must pass the acceptance and periodic testing specified in Chapter 8 of the SARP.

(4) The RTG Package must be operated and maintained as specified in Chapter 7 of both the SARP and the Addendum and Chapter 8 of the SARP.

(5) The operation control limits for radiation dose rates given in Section 7.1.6(5) of the SARP, which are lower than those of 10 CFR 71.47, apply if coolant is present in the cooling channels.

(6) The RTG Package may not be covered with a tarpaulin or other material that impedes natural convection heat transfer.

(7) The RTG Package is subject to a lifetime limit of 1000 load/unload operations. Load/unload cycle data are considered lifetime records and must be maintained by the owner of the package, as described in Section 9 of the SARP.

(8) Two HPG MOD-3 RTGs must be separated by at least 2.90 m (9.5 ft) center to center in a single shipment.

Department of Energy
Washington, DC 20585

PACKAGING CERTIFICATION APPROVAL RECORD

Certificate of Compliance USA/9904/B(U)F-85 (DOE), Revision 2
Radioisotope Thermoelectric Generator (RTG) Package
Dockets 95-16-9904 and 97-15-9904

Revision 2 makes the following changes:

1. The High Performance Generator (HPG) MOD-3 is added as an authorized content of the RTG Package, and

2. Revision 0-B replaces Revision 0 of the Safety Analysis Report for Packaging as the basis for this Certificate.

Addendum HNF-SD-RTG SARP-002, Revision 0, which demonstrates that the HPG MOD-3 RTG complies with the regulations when transported in the RTG Package, was reviewed by the EM-70 Staff. The Staff performed independent analysis as deemed necessary and determined that the HPG MOD-3 in the RTG Package complies with the transportation regulations (Docket 95-16-9904).

Revision 0-B of WHC-SD-RTG-SARP-001 of the SARP for the RTG Package adds arguments to demonstrate compliance with the regulations that became effective April 1, 1996 as required in Reference 1 and it also incorporates the arguments from Reference 2 justifying a change in the leak testing period. The EM-70 Staff determined that Revision 0-B adequately demonstrates compliance with the 1996 regulations and the basis for the leak testing period (Docket 97-15-9904). The EM-70 Staff has previously determined that the RTG complies with the 1996 regulations and that the leak testing period complies with the regulations.

Certificate 9904 constitutes authority for the Department of Energy to use the RTG Package for shipping the GPHS (General Purpose Heat Source) and HPG MOD-3 RTGs in accordance with 49 CFR 173.7(d).

Michael E. Wangler, Director
Package Certification and Safety Program
Office of Site Operations, EM-70

Date MAY 27 1999

References:

1. Memorandum, M. Wangler to J. Mecca, Revision 0, Certificate of Compliance USA/9904/B(U)F-85 (DOE) RTG Package, Docket 94-6-9904, June 19, 1996.

2. Letter, W. F. Irvine to T. K. Teynor, Radioisotope Thermoelectric Generator Package Periodic Leakage Rate, RFSH-9655764, December 12, 1996